INFORMATION CIRCULAR 72

Coal Reserves of Pennsylvania: Total, Recoverable, and Strippable (January 1, 1970)

by William E. Edmunds

Pennsylvania Geological Survey

Prepared in cooperation with the
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PREFACE

For over a century and a half, coal has been a significant element in the public and private life of Pennsylvania. In the course of long-term planning, government agencies, the mining industries, and other groups find it valuable to have an estimate of the amount of coal remaining within the Commonwealth and its various counties.

Several estimates of Pennsylvania coal reserves have been produced previously, the last almost thirty years ago. This report revises those earlier reserve figures to January 1, 1970.

The summary figures for Pennsylvania are as follows:

In-place coal reserves:
  Original—103 billion tons.
  Mined out and lost—22 billion tons.
  Remaining—81 billion tons.

Recoverable coal reserves (i.e. potential production):
  Bituminous over 24 inches—27 billion tons.
  Bituminous over 28 inches—22 billion tons.
  Bituminous over 36 inches—12 billion tons.
  Anthracite over 24 inches—8 billion tons.
  All coal over 24 inches—35 billion tons.

Recoverable stripping coal reserves (16 southwestern bituminous counties only): ¾ billion tons.

Allowing for some excessive generosity in recoverable reserve estimates and the moribund state of the anthracite industry, the overall probable coal production potential for Pennsylvania is actually about 8 to 9 billion tons of readily minable deep-mine coal and 1 billion tons of readily minable stripping coal. At present rates of production this is sufficient deep coal for 150 years and strip coal for 50 years. In addition, there is about another 5 or 6 billion tons of marginal deep coal and another 1 billion tons of marginal strip coal.

About one-half of the readily minable deep coal is in Washington and Greene Counties with important additional reserves in Westmoreland, Somerset, Indiana, Fayette, and Armstrong Counties.

Most of the important stripping reserves are in Armstrong, Butler, Clarion, Clearfield, Somerset, and Washington Counties.

In spite of the presence of very large amounts of thick, high-quality, low-sulfur coal in the anthracite fields, the economics of production seem to be such that very little can be considered a likely source of future production.

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Coal Reserves of Pennsylvania: Total, Recoverable, and Strippable (January 1, 1970)

by

William E. Edmunds

ABSTRACT

Approximate coal reserves of Pennsylvania are as follows:

- A. In-place reserves (as of 1/1/1970)
  1. Original—103 billion short tons (79 billion bituminous and 24 billion anthracite).
  2. Mined out and lost—22 billion short tons (14 billion bituminous and 8 billion anthracite).
  3. Remaining—81 billion short tons (65 billion bituminous and 16 billion anthracite).
  4. Remaining Pittsburgh seam—7 billion short tons.
- B. Recoverable reserves (as of 1/1/1970)
  1. Bituminous over 24 inches thick—27 billion short tons.
  2. Bituminous over 28 inches thick—22 billion short tons.
  3. Bituminous over 36 inches thick—12 billion short tons.
  4. Anthracite over 24 inches thick—8 billion short tons.
  5. All coal over 24 inches thick—35 billion short tons.
- C. Strippable coal reserves over 24 inches thick for 16 southwestern bituminous counties (as of 1/1/1968)
  1. In-place coal with less than 120 feet of cover—2.3 billion tons.
  2. Recoverable coal with less than 120 feet of cover—1.8 billion tons.
  3. Recoverable coal with cover less than 15 times the average seam thickness—0.75 billion tons.

The overall accuracy of the figures is ±50%, except for reserves on the Pittsburgh seam which is ±20%. The "in-place" and "strippable" figures are believed to be fairly realistic, but the "recoverable" reserves are probably generous by, perhaps, 30%.

For economic reasons, the large reserves of the anthracite fields cannot be considered as a likely source of future production.

As a practical estimate, Pennsylvania's readily minable, recoverable reserves are as follows:

Deep (over 36 inches)—8 to 9 billion tons.

Strip (over 24 inches with cover less than 15 times seams thickness)—1 billion tons.

Total recoverable—9 to 10 billion tons.

At the present rate of production, these figures represent about 50 years of strip mining and 150 years of deep mining.

One-half the readily minable deep coal reserves are in Washington and Greene Counties with important additional reserves in Armstrong, Fayette, Indiana, Somerset, and Westmoreland Counties. Principal readily minable stripping reserves are in Armstrong, Butler, Clarion, Clearfield, Somerset, and Washington Counties.

ACKNOWLEDGEMENTS

The computation of reserve tonnages for the section on strippable coal reserves in the 16 southwestern counties was prepared by personnel of the U. S. Bureau of Mines as part of a nationwide study of strippable bituminous coal and lignite reserves entitled:

The reserves of bituminous coal and lignite for strip-mining in the United States, Information Circular 8531.

Permission to use this information was generously granted by the U. S. Bureau of Mines.

The research and tabulation of production from the Pittsburgh seam from the dates of the previous estimates to January 1, 1970, was done by Mrs. Deborah Lehmer of the Pennsylvania Geologic Survey staff.

INTRODUCTION

From the earliest days of coal mining in Pennsylvania there has been a continuing interest in where and how much coal is actually present. Both the mining industry and government agencies must consider coal reserves in the course of long-term planning. For general planning purposes, usually a reasonably accurate estimate is needed, rather than a precise figure. For this reason, general coal reserve reports, including this one, are designed to give approximate tonnages. While it would be possible to increase the accuracy of the figures in all cases, the enormous additional expenditure in time and effort needed to produce small improvements is difficult to justify.

As is customary, this report gives two basic types of coal reserves—in-place and recoverable.

In-place or total reserves are a measure of the actual amount of coal present in the ground, excluding beds below a certain thickness as being of no economic value whatsoever.

Recoverable reserves are an estimate of the amount of coal which can actually be produced from the coal present allowing for operational and various other losses. Recoverable reserves can be further categorized as readily recoverable, marginally recoverable, and remotely recoverable depending upon the state of the mining art, economics, legal considerations, and other factors. At the present time in Pennsylvania, only deep coal over 36 inches and strippable coal over 24 inches can be considered readily recoverable. In addition, economics seems to dictate that very little of the large reserves of fine coal in the Anthracite Fields can be considered readily recoverable no matter what its thickness and quality.

Additionally, because strip mining operations are mechanically limited by the amount of overburden covering a seam, special in-place and recoverable stripping reserve tables are also included.

COAL FIELDS AND COAL SEAMS

Coal seams underlie about 15,000 square miles (33%) of Pennsylvania. Geographically, the coal-bearing areas are divided into the following eight fields (Figure 1):

1. Main Bituminous Field
2. Georges Creek Field
3. Broad Top Field
4. North-central Fields (5 small fields)
5. Northern Anthracite Field
6. Western Middle Anthracite Field
7. Eastern Middle Anthracite Field
8. Southern Anthracite Field

Historically, most coal production has come from the Main Bituminous Field and the four Anthracite Fields. With the decline of anthracite production in recent years, the Main Bituminous Field now dominates the coal picture.

Because of the difficulty in establishing bed correlations among all of the eight coal fields, five sets of bed nomenclature are employed in Pennsylvania as shown in Figures 2 through 5.

PREVIOUS COAL RESERVES STUDIES

TOTAL RESERVES

H. D. Rogers (1858) estimated the in-place coal reserves of "workable" beds in Pennsylvania to be 316.4 billion tons. Apparently this figure had been current for some years previous, as R. C. Taylor (1855, p. 326-327) specified that the 300 billion tons given "on the authority of the state geologists" is excessive and implies that it is so by a factor of 2½.

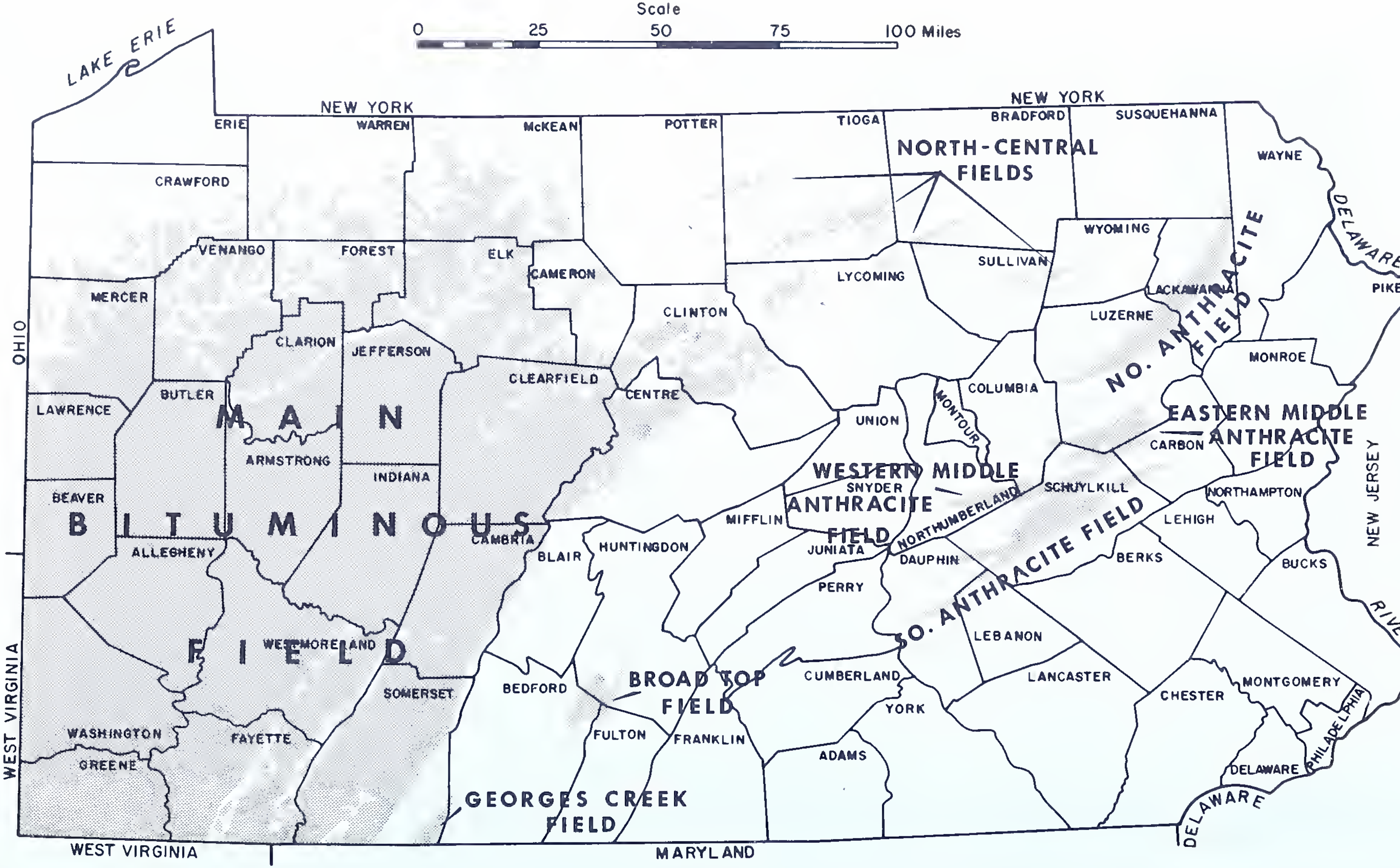

Figure 1. Coal fields of Pennsylvania

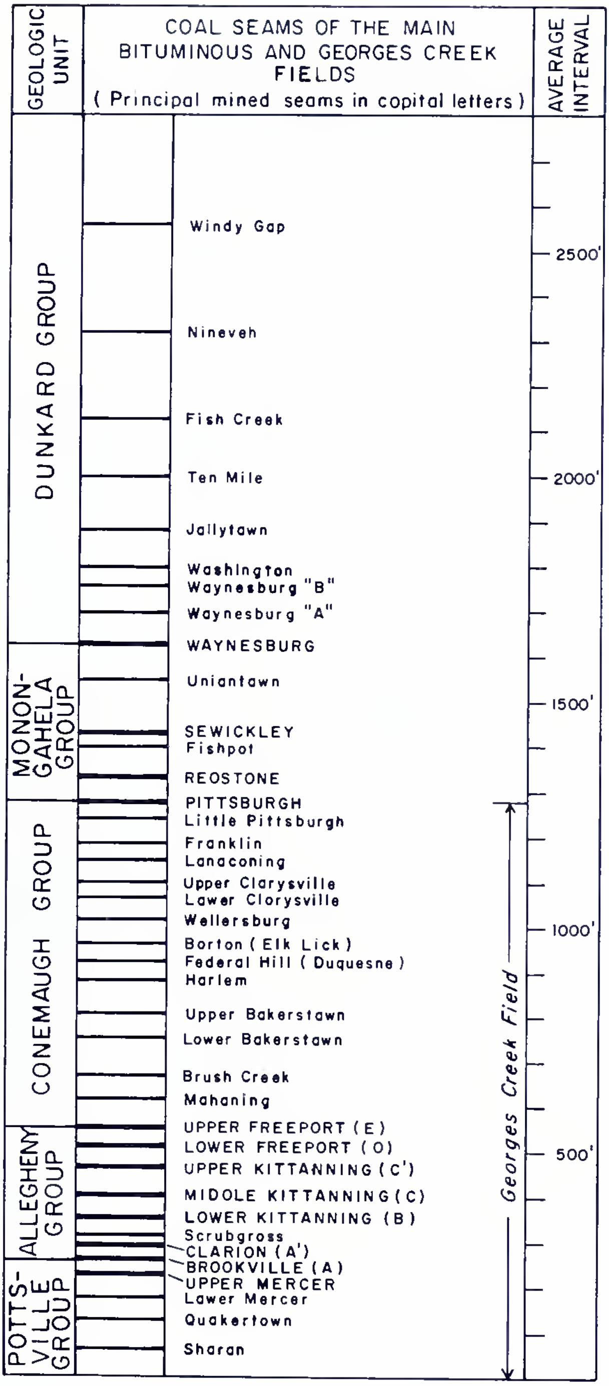

Figure 2. Coal seams of the Main Bituminous and Georges Creek Fields.

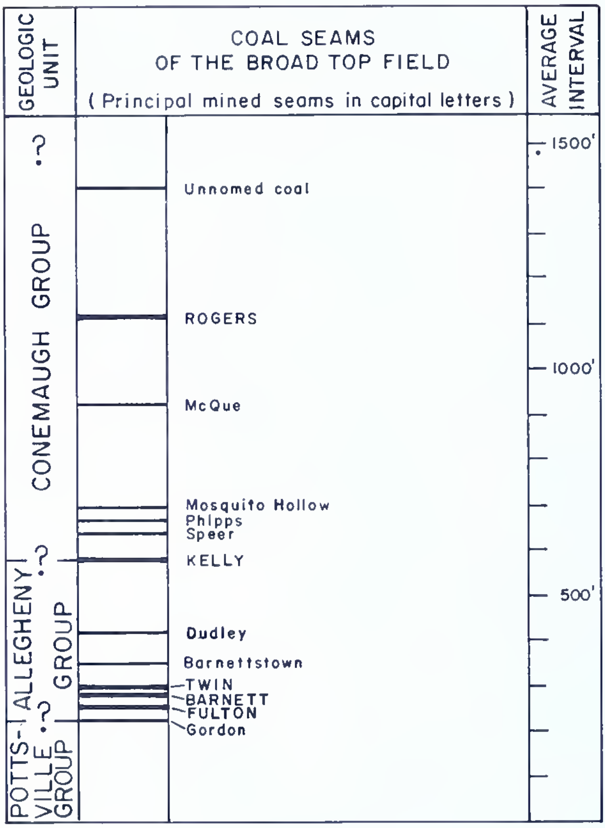

Figure 3. Coal seams of the Broad Top Field.

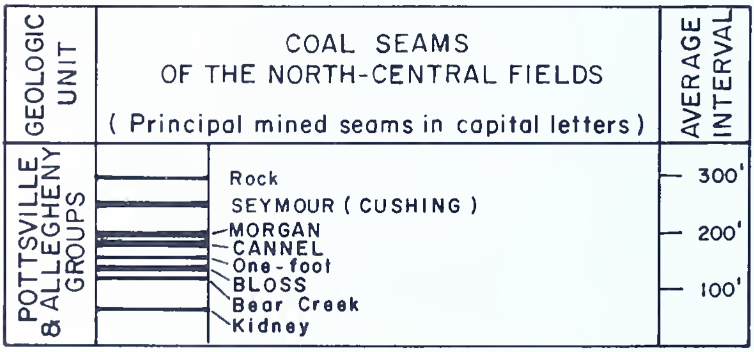
GEOLOGIC UNIT
COAL SEAMS OF THE NORTH-CENTRAL FIELDS
(Principal mined seams in capital letters)
AVERAGE INTERVAL
POTTSVILLE & ALLEGHENY GROUPS
Rock
SEYMOUR (CUSHING)
MORGAN
CANNEL
One-foot
BLOSS
Bear Creek
Kidney
300'
200'
100'

Figure 4. Coal seams of the North-Central Fields.

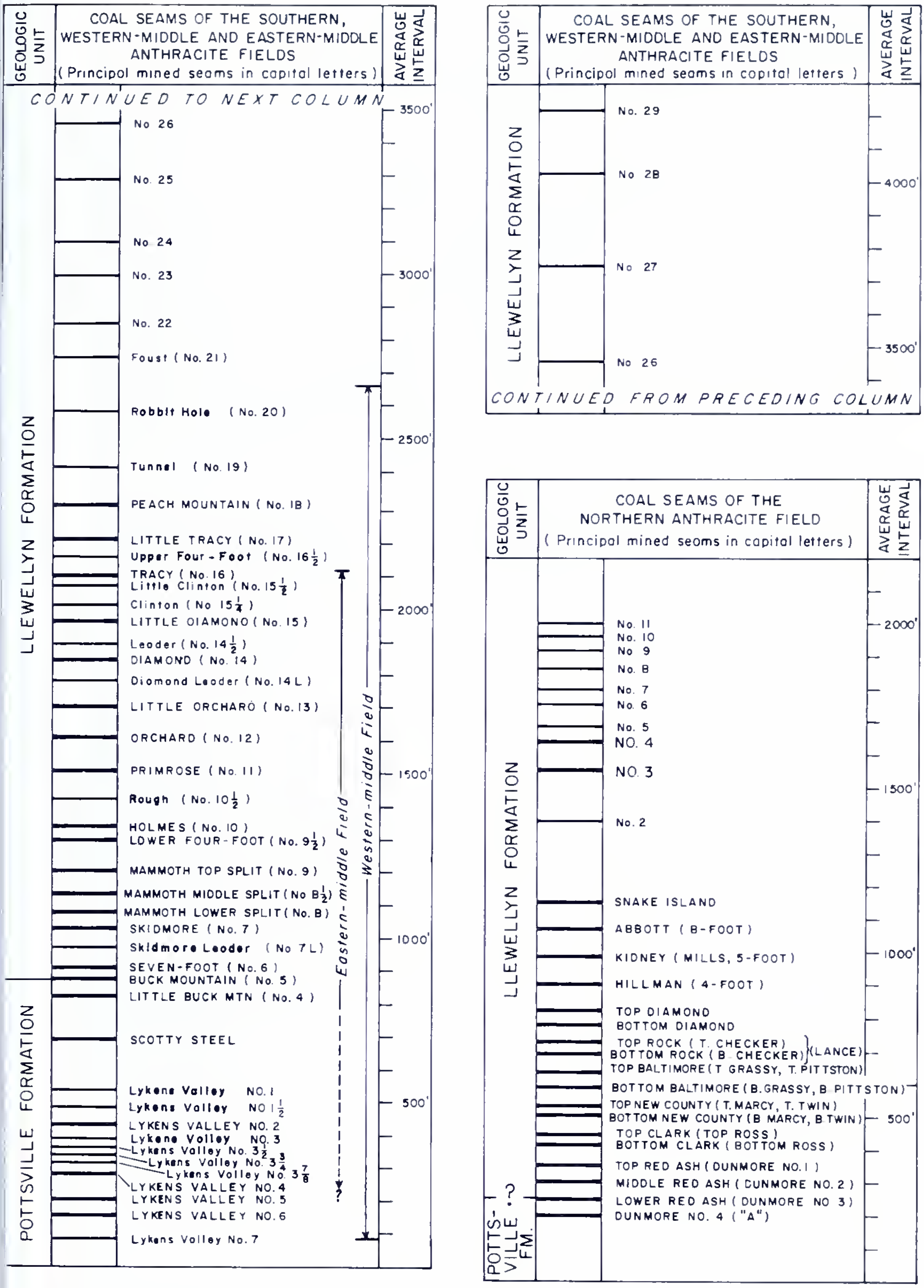

Figure 5. Coal seams of the Southern, Western-Middle, and Eastern-Middle Anthracite Fields.
Coal seams of the Northern Anthracite Field.

BITUMINOUS RESERVES

Chance (1882)

H. M. Chance (1882) produced a remarkably accurate reserve estimate when he calculated that workable, in-place bituminous reserves over 36 inches thick aggregated about 30.5 billion tons. Since 1882 bituminous production and losses (mostly from beds over 36 inches) have been about 14 billion tons and remaining in-place workable reserves today are estimated to be about 16 billion tons. The total of 30 billion tons is exceedingly close to Chance's 30.5 billion tons. While there is no doubt that the apparent accuracy of Chance's figures is due in part to fortuitous averaging of individual county and seam tonnages, his estimates were a great improvement on enormously inflated earlier estimates.

Campbell and Parker (1909)

Campbell and Parker (1909) cite Pennsylvania bituminous reserves as 112.5 billion tons, but do not explain the source of this number. It is undoubtedly an in-place estimate of all coal over 14 or 18 inches thick, and a vast overstatement of the actual amount of coal which was then, is now, or foreseeably will be minable. Campbell (1913) essentially repeats these same figures.

Johnston (1920)

In 1920 J. K. Johnston, an obscure, but talented and knowledgeable geologist-engineer for the Pennsylvania Railroad, produced an elaborate summary of Pennsylvania's in-place coal reserves over two feet thick. Johnston's estimate was an exceedingly optimistic 109 billion original tons. This figure would more likely approximate the total in-place reserves over 14 inches thick.

Reese and Sisler (1928)

J. F. Reese and J. D. Sisler (1928) recomputed Pennsylvania's bituminous coal reserves from scratch, and estimated the original in-place reserves over 18 inches thick at 75 billion tons. Production and losses to that time reduced this figure to about 69 billion tons. Reese and Sisler estimated recoverable reserves at 44 million tons, but, as this includes large amounts of coal in the lower part of the thickness range, it is excessively high. Ashley (1944) rejected their recoverable figures and reduced all except the Pittsburgh seam by 40 percent while raising the minimum thickness to 24 inches. Reese and Sisler's original in-place reserves seem fairly realistic for an 18-inch minimum thickness. With a few exceptions Reese and Sisler's original in-place tonnages are used as the base figures for in-place tonnages in this report.

Ashley (1944)

G. H. Ashley (1944) produced a new set of coal reserve figures for the bituminous area, based on the work of Reese and Sisler (1928), but with extensive revisions, not only from additional mining, but also in original tonnages. In particular, Ashley concluded that the recoverable tonnages given by Reese and Sisler were much too high and unrealistically based on a minimum thickness of 18 inches. Ashley revised the minimum thickness to 24 inches and in doing so reduced Reese and Sisler's tonnages by 40 percent except on the Pittsburgh seam. In addition, Ashley broke recoverable reserves into an over-36-inch category. Ashley's reduction of recoverable tonnages was almost certainly a realistic step, but probably did not go far enough. With a few exceptions, Ashley (1944) is the base for recoverable bituminous reserves and mined and lost figures to 1944 used in this report.

U. S. Bureau of Mines

Between 1950 and 1956, the U. S. Bureau of Mines produced reserve studies for the 12 largest producing bituminous counties. These reports were not intended to give complete county coal reserves, but were limited to the more narrow subject of clearly indicated reserves of coking coal. For this reason, extensive areas of most coal beds in most counties are excluded from the estimate. Only the Pittsburgh coal is completely estimated throughout its entire extent, and this is the source of the reserves on the Pittsburgh in this report. The bibliographic references to these reports are Dowd and others (1950a, 1950b, 1951a, 1951b, and 1952), Wallace and others (1953a, 1953b, 1955a, and 1955b), and Blaylock and others (1955 and 1956).

U. S. Geological Survey

Patterson (1963), Van Lieu and Patterson (1964), and Patterson and Van Lieu (1969) recalculated the reserves of Beaver, Lawrence, and Butler Counties respectively from scratch. These studies are the basis of all figures on those counties included in this report.

ANTHRACITE RESERVES

Sheafer (1879)

In a paper presented before the American Association for the Advancement of Science on September 1, 1879, P. W. Sheafer (cited in Chance, 1882) reported the in-place anthracite reserves to be 29.0 billion short tons (converted from 26.4 billion long tons).

Harris (1880)

J. S. Harris in a report to the Philadelphia and Reading Coal and Iron Company (cited by Chance, 1882) estimated the available in-place reserves of the four Anthracite Fields to be 17.2 billion short tons (converted from 15.6 billion long tons).

Harris (1892)

Harris (1892) slightly revised his earlier estimate of original in-place reserves to 15.9 billion short tons (14.5 billion long tons), and reported remaining recoverable reserves to be 6.6 billion short tons (6.0 billion long tons) remaining at that date.

Smith (1893)

A. D. W. Smith (1893) estimated the original in-place reserves over 2 feet thick (2.5 feet in the Northern Field) to be about 21.5 billion short tons (19.5 billion long tons) with 18.7 billion short tons remaining at that time. Smith calculated that about 7.5 billion short tons could be recovered.

Campbell and Parker (1909)

Campbell and Parker (1909) reproduced the figures given by Smith (1893), but estimated the recovery rate to be higher. They calculated recoverable reserves to be 9.5 billion short tons (8.6 billion long tons) rather than 7.5 billion short tons. This revision seems to have been justified overall.

Ashmead (1926)

D. C. Ashmead (1926) recomputed the anthracite reserves at 22.9 billion short tons (20.8 billion long tons), a small increase in Smith's 1893 estimate. Ashmead's reserve figures, with some later revisions by Ashley (1945) and others, are the basis for anthracite reserves in this report.

Ashley (1945)

Ashley (1945) brought the remaining anthracite reserves up to that year. With some modifications, Ashley's figures are based on Ashmead (1926), and are, in turn, the basis of this report.

IN-PLACE COAL RESERVES

In-place coal reserves refer to the amount of coal over a certain thickness actually present in the ground. The minimum thickness selected has usually been a figure believed to represent the least potential thickness which could conceivably be mined. Hence, the in-place reserves are supposed to be the amount of potentially minable coal in the ground, which when reduced by a factor to allow for mining losses (usually 50%) will also equal ultimate potential production.

In the earlier studies of Pennsylvania reserves, upon which this report is based, 18 inches was the minimum thickness allowed in bituminous counties (Reese and Sisler, 1928) and 24 inches the minimum in anthracite counties (Ashmead, 1926) except in a few cases computed by the U. S. Geological Survey where 14 inches was the minimum.

Table 1 gives the in-place reserves originally calculated in earlier studies, brought up to January 1, 1970, by subtraction of intervening production and losses. Appendix Table A shows the complete unrounded calculation procedures employed in deriving Table 1. The figures in Table 1 are rounded to the first two digits obtained in Appendix Table A on the basis that only the first digit has any potential significance and the second digit has a partial significance in showing the magnitude and direction of the variations from the first digit. No other digits beyond the first two can be considered to have any real significance whatsoever. The complete figures in Appendix Table A are included however to allow the continual subtraction of the relatively small annual production and loss figures from future years.

Although original tonnages given in the base sources were computed by seam in all cases, the records of production did not keep track of seams with sufficient regularity or reliability to permit these original seam figures to be brought up to present. The sole exception is the reserves on the Pittsburgh seam which were calculated in entirety by the U. S. Bureau of Mines in the reports on the various counties involved. In-place tonnages on the Pittsburgh are shown in Table 2.

Overall the reserves shown in Table 1 appear to be a reasonable approximation (± 50%) of the in-place reserves of Pennsylvania. Certain overly optimistic estimates contained in the original base figures are probably offset by deletion of parts of some major seams and all minor seams which may locally exceed the minimum thicknesses.

The U. S. Bureau of Mines base data used for Pittsburgh coal reserves in Table 2 were all in the "measured" and "indicated" category and should thus be fairly reliable (± 20%).

RECOVERABLE COAL RESERVES

As opposed to in-place reserves, recoverable coal reserves are intended to give an estimate of the amount of coal which can be actually extracted and utilized. It has been found in practice that only 40 to 70 percent of the original in-place coal of an area can be recoverable by deep mining procedures, and perhaps 80 percent overall by strip mining. The remainder is permanently lost.

Usually it is customary to indicate potential recoverable reserves by taking the original in-place reserves and reducing them by a realistic loss factor. To use the in-place reserves shown in Figure 1 and reduce them by, say, 50 percent will, however, yield an extremely high figure for recoverable reserves. The problem arises from the custom of considering seams as thin as 14 or 18 inches to be potentially minable. Although it is remotely conceivable that such thin coals might be extensively mined, the possibility in Pennsylvania is exceedingly remote. Those wishing to carry potential reserves down to the 14- to 18-inch level may readily do so by reducing the in-place figures of Table 1 by 50%.

Table 1
In-place Coal Reserves of Pennsylvania by Counties as of January 1, 1970 (Millions of short tons)

Field County	Minimum thickness included	Mined out and lost to 1/1/70	Remaining in-place reserves 1/1/70
MAIN BITUMINOUS AND GEORGES CREEK FIELDS			
Allegheny	18″	1,800	1,400
Armstrong	"	430	3,300
Beaver	14″	34	2,500
Blair	18″	35	43
Butler	14″	230	3,400
Cambria	18″	1,500	3,900
Cameron	"	2	59
Centre	"	140	370
Clarion	"	190	1,900
Clearfield	"	680	3,300
Clinton	"	40	75
Elk	"	100	460
Fayette (not specified but 24″ or less)		2,300	5,300
Greene	18″	610	8,900
Indiana	"	900	5,400
Jefferson	"	430	2,900
Lawrence	14″	44	740
McKean	18″	1	420
Mercer	"	110	390
Somerset	"	610	5,500
Venango	"	17	380
Washington	"	1,600	8,900
Westmoreland	"	1,800	4,600
Total	14″ & 18″	14,000	64,000
BROAD TOP FIELD			
Bedford	18″	58	200
Fulton	"	3	27
Huntingdon	"	40	85
Total	18″	100	310
NORTH-CENTRAL FIELDS			
Bradford	18″	20	24
Lycoming	"	9	63
Sullivan	24″	26	9
Tioga	18″	36	120
Total	18″ & 24″	91	220

Table 1 (continued)

Field County	Minimum thickness included	Mined out and lost to 1/1/70	Remaining in-place reserves to 1/1/70
ANTHRACITE FIELDS			
Carbon	24″	320	310
Columbia	″	130	480
Dauphin	14″	140	740
Lackawanna	24″	1,600	390
Lebanon	14″	4	1,000
Luzerne	24″	2,800	1,700
Northumberland	″	680	1,900
Schuylkill	″	2,200	9,900
Susquehanna	″	10	5
Wayne	″	4	6
Total	24″	8,000	16,000
Pennsylvania Total	14″, 18″, & 24″	22,000	81,000

Note: Numbers will not total exactly because of independent rounding. Figures are rounded to first two digits (first digit if 9 million or less). See Appendix Table A for base data and unrounded calculation procedures.)

Table 2
In-place Reserves of the Pittsburgh Coal as of January 1, 1970 (Millions of tons)

County	Remaining in-place reserves over 14 in. (millions of tons)	Remaining in-place reserves over 28 in.* (millions of tons)
Allegheny	36	36
Armstrong	10	10
Beaver	Exhausted	Exhausted
Fayette	19	19
Greene	3,700	3,700
Indiana	5	5
Somerset	31	31
Washington	3,200	3,200
Westmoreland	140	140
Total for Pa.	7,100	7,100*

* Over 99% of the reserves over 28 inches thick are also over 42 inches thick.

Figures are rounded to first two digits (or first digit if 9 million or less). Figures do not add to total due to independent rounding. See Appendix Table B for base data and unrounded calculation procedures.)

Realistically, in this author's opinion, it is very unlikely that any considerable deep mining will be carried out on coal beds less than 28 inches thick. Only seams exceeding 36 inches can presently be considered readily minable underground, with beds between 28 and 36 inches as a very marginal resource. Strip mining can readily handle coal seams down to 24 inches with marginal possibilities to 18 inches. In Table 3 recoverable reserves are given in terms of seam thicknesses exceeding 24, 28, and 36 inches. The 28-and 36-inch figures correspond to the potentially deep-minable coal mentioned above. The 24-inch figure is included to allow presentation of the estimated recoverable reserves from the anthracite counties for which there are no base figures other than 24 inches. Although they cannot be reduced to exact numbers, a very large percentage of the anthracite seams thicker than 24 inches are over 28 and even 36 inches as well.

Estimating the potential recoverable reserves of the four anthracite fields is a difficult problem in any case. In spite of the impressive tonnages of good quality, low-sulfur anthracite remaining in thick seams, the economics of production and marketing has apparently eliminated most anthracite from consideration at present. The steeply dipping and faulted nature of the anthracite beds has greatly accentuated a number of normal mining problems to a point where operations are prohibitively expensive. The markets, which at one time could pay the premium price of this fine fuel, have slipped away, while the once-giant anthracite industry, with all its specialized miners, technicians, and engineers has deteriorated to such an extent, that even the recent upsurge in needs and prices for low-sulfur, clean-burning coal has been unable to stimulate a response. It is difficult at present to characterize any significant amount of anthracite as a recoverable reserve.

The base data from which the recoverable reserves shown in Table 3 are drawn are from Ashley (1944) for most bituminous counties, and from Ashley (1945) for most anthracite counties. Exceptions are annotated in the footnotes to Appendix Table B which also shows the unrounded calculation procedures from which Table 3 is derived.

The bituminous reserves figures in Ashley (1944) were based initially on those given in Reese and Siler (1928). Ashley concluded that the reserves of Reese and Sisler were unreasonably high and reduced them by 40 percent except for the Pittsburgh seam. Ashley's reductions appear to be justified and, in this author's opinion, were probably insufficient. Consideration was given here to further reducing Ashley's base bituminous figures by one-third, but the idea was discarded because of the difficulty in reliably applying the reduction to each individual county. Nonetheless, in this author's opinion, the total bituminous recoverable reserves in each thickness category of Table 3 are probably about one-third too high.

In addition to the total recoverable reserves for each county, an estimate is given in Table 3 of the proportion of these reserves which are expected to fall in the different rank categories.

STRIPPABLE COAL RESERVES

The strippable coal reserves included in this report were drawn from a study conducted by the U. S. Bureau of Mines on national reserves of strippable bituminous coal and lignite entitled:

The reserves of bituminous coal and lignite for strip-mining in the United States, Information Circular 8531.

Certain changes in seam nomenclature and table organization were made by this author. All such modifications are indicated in footnotes to the various tables.

Estimates of strippable coal reserves for beds averaging 28 inches thick or more in the 16 southwestern Pennsylvania counties shown in Figure 6 are given in Tables 4, 5, and 6. The estimates are given as:

(1) remaining in-place tonnages with less than 120 feet of overburden.

(2) remaining in-place tonnages, with less than 120 feet of overburden, less 20% mining loss allowance.

(3) remaining in-place tonnages with overburden less than 15 times the average coal seam thickness, less 20% mining loss allowance.

In addition, Table 7 gives an approximation of the amount of medium- and high-sulfur coal available for strip mining. Figures are as of January 1, 1968.

The calculation procedures used in this study were designed to yield generally conservative results. In most cases, the tonnages should represent minimum, but fairly realistic, reserve figures for the counties and seams covered.

The report does not include estimates for all bituminous coal counties or any of the anthracite counties (Figure 6). In 1969, counties included in this report produced 18,555,763 tons of strip coal. Bituminous counties outside this report produced 3,096,968 tons of strip coal and anthracite counties 4,696,123 tons of strip coal. Based on these figures, the counties included in this report contributed 70.4% of Pennsylvania's total strip mine production (85.7% of bituminous strip mine production) in 1969. As coal production is not solely a function of reserves, it would be improper to assume that Pennsylvania's total strippable coal reserves would bear a proportional relation to total production. Still, it is worth

Table 3. *Recoverable coal reserves of Pennsylvania over 24, 28, and 36 inches thick by counties and rank as of January 1, 1970 (millions of short tons).*

FIELD COUNTY[1]	Recoverable reserves over 24 inches thick						Recoverable reserves over 28 inches thick						Recoverable reserves over 36 inches thick					
	Total > 24"	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite	Total > 28"	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite	Total > 36	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite
MAIN BITUMINOUS AND GEORGES CREEK FIELDS																		
Allegheny	850	850	—	—	—	—	680	680	—	—	—	—	260	260	—	—	—	—
Armstrong	1,200	1,200	—	—	—	—	1,100	1,100	—	—	—	—	830	830	—	—	—	—
Beaver	680	680	—	—	—	—	350	350	—	—	—	—	200	200	—	—	—	—
Blair	11	—	8	3	—	—	9	—	7	2	—	—	3	—	2	1	—	—
Butler	1,100	1,100	—	—	—	—	860	860	—	—	—	—	370	370	—	—	—	—
Cambria	1,400	—	560	840	—	—	1,000	—	400	600	—	—	390	—	160	230	—	—
Cameron	18	12	6	—	—	—	13	9	4	—	—	—	0	0	0	—	—	—
Centre	120	—	120	—	—	—	83	—	83	—	—	—	3	—	3	—	—	—
Clarion	630	630	—	—	—	—	450	450	—	—	—	—	80	80	—	—	—	—
Clearfield	1,000	250	750	—	—	—	710	180	530	—	—	—	90	22	68	—	—	—
Clinton	15	—	15	—	—	—	9	—	9	—	—	—	6	—	6	—	—	—
Elk	140	140	—	—	—	—	110	110	—	—	—	—	46	46	—	—	—	—
Fayette	2,500	2,000	500	—	—	—	2,100	1,700	400	—	—	—	1,100	830	270	—	—	—
Greene	4,500	4,500	—	—	—	—	4,000	4,000	—	—	—	—	2,700	2,700	—	—	—	—
Indiana	2,100	1,600	500	—	—	—	1,700	1,300	400	—	—	—	630	470	160	—	—	—
Jefferson	1,100	1,100	—	—	—	—	880	880	—	—	—	—	260	260	—	—	—	—
Lawrence	160	160	—	—	—	—	150	150	—	—	—	—	77	77	—	—	—	—
McKean	130	130	—	—	—	—	96	96	—	—	—	—	5	5	—	—	—	—
Mercer	110	110	—	—	—	—	82	82	—	—	—	—	21	21	—	—	—	—
Somerset	2,000	—	1,000	1,000	—	—	1,600	—	800	800	—	—	670	—	340	330	—	—
Venango	120	120	—	—	—	—	81	81	—	—	—	—	7	7	—	—	—	—
Washington	4,300	4,300	—	—	—	—	3,800	3,800	—	—	—	—	2,600	2,600	—	—	—	—
Westmoreland	2,200	1,700	500	—	—	—	1,900	1,500	400	—	—	—	1,300	1,000	260	—	—	—
Field Totals	27,000	21,000	4,000	1,800	—	—	22,000	17,000	3,000	1,400	—	—	12,000	9,800	1,300	560	—	—

BROAD TOP FIELD																		
Bedford	70	—	—	70	—	—	66	—	—	66	—	—	57	—	—	57	—	—
Fulton	10	—	—	10	—	—	8	—	—	8	—	—	4	—	—	4	—	—
Huntingdon	24	—	—	24	—	—	18	—	—	18	—	—	6	—	—	6	—	—
Field Totals	100	—	—	100	—	—	91	—	—	91	—	—	67	—	—	67	—	—
NORTH-CENTRAL FIELDS																		
Bradford	6	—	—	6	—	—	4	—	—	4	—	—	1	—	—	1	—	—
Lycoming	23	—	23	—	—	—	17	—	17	—	—	—	4	—	4	—	—	—
Sullivan	4	—	—	—	4	—	3	—	—	—	3	—	0	—	—	—	0	—
Tioga	19	—	19	—	—	—	13	—	13	—	—	—	4	—	4	—	—	—
Field Totals	52	—	42	6	4	—	38	—	30	6	3	—	9	—	8	1	0	—
ANTHRACITE FIELDS																		
Carbon	150	—	—	—	—	150	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Columbia	240	—	—	—	—	240	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Dauphin	350	—	—	—	170	180	330	—	—	—	160	170	[4]	—	—	—	[4]	[4]
Lackawanna	170	—	—	—	—	170	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Lebanon	470	—	—	—	—	470	450	—	—	—	—	470	[4]	—	—	—	—	[4]
Luzerne	820	—	—	—	—	820	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Northumberland	940	—	—	—	310	620	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Schuylkill	4,900	—	—	—	500	4,400	[2]	—	—	—	[2]	[2]	[4]	—	—	—	[4]	[4]
Susquehanna	2	—	—	—	—	2	[2]	—	—	—	[2]	[2]	[4]	—	—	—	[4]	[4]
Wayne	3	—	—	—	—	3	[2]	—	—	—	—	[2]	[4]	—	—	—	—	[4]
Field Total	8,000	—			980	7,100	[2]	—	—	—	[2]	[2]	[4]	—	—	—	[4]	[4]
PENNSYLVANIA TOTAL	35,000	21,000	4,000	1,800	980	7,100	22,000[3]	17,000	3,100	1,500	3[3]	[2]	12,000[3]	9,800	1,300	630	0[3]	[4]

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[1] Excludes small recoverable reserves from Crawford, Erie, Forest, Potter, Warren, and Wyoming Counties.

[2] Reserves in beds over 28 inches cannot be separately calculated, but in most cases should be 90% or more of the tonnages in beds over 24 inches.

[3] Excludes counties of the Anthracite Fields.

[4] Reserves over 36 inches cannot be separately calculated.

Figures are rounded to first two digits (first digit if 9 million or less). Numbers will not total exactly because of independent rounding. See Appendix Tables C and D for base data and unrounded calculation procedures.

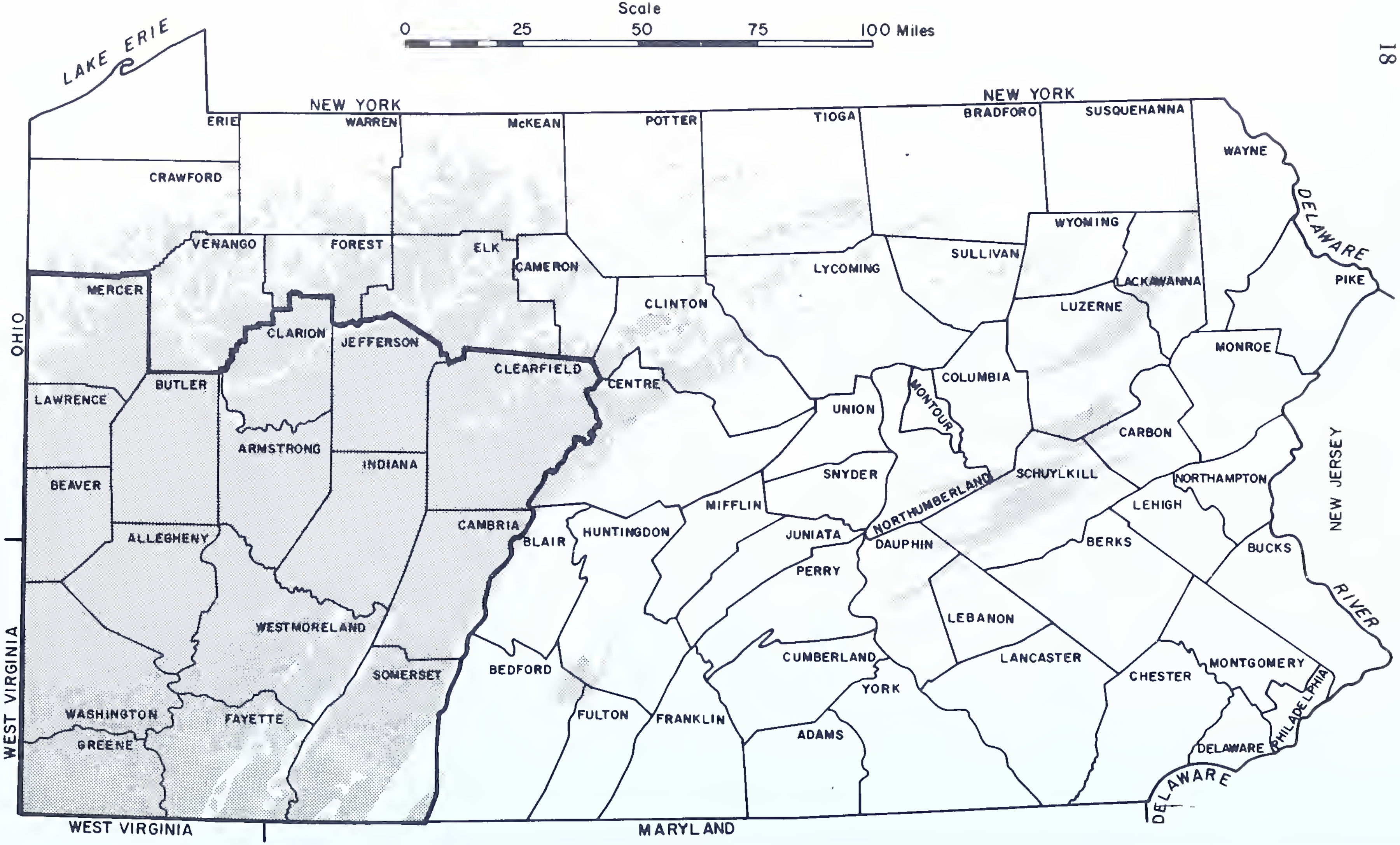

Figure 6. Map of counties included in the strippable reserve study (heavy outline).

Table 4. Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by county (thousands of short tons).[1]

County	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15× average seam thickness less 20% mining loss
Allegheny	48,200	38,500	18,700
Armstrong	216,900	173,500	66,300
Beaver	79,600	63,700	26,000
Butler	306,900	245,500	100,000
Cambria	92,800	74,200	27,400
Clarion	236,700	189,400	71,100
Clearfield	298,800	239,000	87,600
Fayette	122,100	97,800	44,100
Greene	70,300	56,300	35,300
Indiana	95,300	76,300	32,100
Jefferson	129,800	103,900	38,000
Lawrence	46,200	37,000	14,400
Mercer	93,300	74,700	30,900
Somerset	175,500	140,400	56,500
Washington	204,400	163,500	81,700
Westmoreland	55,700	44,500	22,200
Total	2,272,500	1,818,200	752,300

[1] Adapted from Table A63 of *The reserves of bituminous coal and lignite for strip-mining in the United States,* U. S. Bureau of Mines, Information Circular 8531 and unpublished data.

noting that there are significant strippable reserves in areas beyond the limits of this report.

It should also be pointed out that the coal seams listed for each county (Table 4) do not necessarily represent all the seams present and minable, but do include the principal seams which average 28 or more inches in thickness for an entire county.

The calculation procedure used in determining the amount of coal falling in each of the sulfur-content categories required that the *entire* tonnage for each coal seam in each county be assigned to the category equivalent to the *average* sulfur content of that seam in that county. No attempt was made to prorate fractions of total tonnage to other than the average sulfur-content category. Since no coal seam in Pennsylvania *averages* less than 1% sulfur, no low-sulfur reserves are shown in Table 7 although some do exist. Similarly, medium-sulfur totals are probably somewhat low. In addition, most of Pennsylvania's anthracite would fall in the low-sulfur category.

The procedures followed in obtaining the strippable coal reserves in Tables 4 through 6 is given in the Appendix.

Table 5. Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by seams (thousands of short tons).[1]

Coal Seam	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15× average seam thickness less 20% mining loss
Washington	76,100	60,900	34,700
Waynesburg	188,400	150,700	71,800
Sewickley	22,900	18,400	9,600
Redstone	65,200	52,200	20,100
Pittsburgh	72,000	57,600	37,900
Brush Creek	1,000	800	300
Mahoning	5,900	4,700	2,000
Upper Freeport	596,800	477,300	194,500
Lower Freeport	312,000	249,600	99,800
Upper Kittanning	154,300	123,500	46,700
Middle Kittanning	145,900	116,800	41,900
Lower Kittanning	306,000	244,800	89,900
Clarion[2]	95,900	76,400	30,200
Brookville[3]	142,700	114,200	46,100
Upper Mercer[4]	34,200	27,400	11,300
Lower Mercer	29,900	24,000	8,300
Quakertown	800	600	200
Sharon	22,900	18,300	7,000
Total	2,272,500	1,818,200	752,300

[1] Adapted from Table A62 of *The reserves of bituminous coal and lignite for strip mining in the United States,* U. S. Bureau of Mines, Information Circular 8531.

[2] Referred to as "Upper Clarion" in Table 59 of U. S. Bureau of Mines report.

[3] Revised from Table 59 of U. S. Bureau of Mines report by adding "Lower Clarion" tonnage from Clarion County and subtracting "Brookville" tonnage from Clarion County.

[4] Revised from Table 59 of U. S. Bureau of Mines report by adding "Brookville" tonnage from Clarion County and "Homewood" tonnage from Lawrence County.

Table 6. Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by counties and seams (thousands of short tons).[1]

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15× average seam thickness, less 20% mining loss
Allegheny Co.				
Redstone	39	30,900	24,700	9,600
Pittsburgh	63	7,800	6,200	3,900
Upper Freeport	68	9,500	7,600	5,200
Total		48,200	38,500	18,700
Armstrong Co.				
Pittsburgh	66	5,000	4,000	2,600
Upper Freeport	38	94,400	75,500	28,700
Lower Freeport	41	42,900	34,300	14,100
Upper Kittanning	32	18,700	15,000	4,800
Lower Kittanning	36	55,900	44,700	16,100
Total		216,900	173,500	66,300
Beaver Co.				
Brush Creek	36	1,000	800	300
Mahoning	42	5,900	4,700	2,000
Upper Freeport	42	50,900	40,700	17,100
Lower Freeport	36	11,100	8,900	3,200
Middle Kittanning	36	4,200	3,400	1,200
Lower Kittanning	42	6,500	5,200	2,200
Total		79,600	63,700	26,000
Butler Co.				
Upper Freeport	41	125,300	100,200	41,100
Lower Freeport	43	52,000	41,600	17,900
Middle Kittanning	37	75,200	60,200	22,300
Clarion	43	54,400	43,500	18,700
Total		306,900	245,500	100,000
Cambria Co.				
Upper Freeport	36	22,000	17,600	6,300
Lower Freeport	35	19,300	15,400	5,400
Upper Kittanning	37	23,200	18,600	6,900
Middle Kittanning	35	1,400	1,100	400
Lower Kittanning	39	26,900	21,500	8,400
Total		92,800	74,200	27,400

Table 6 (continued)

Seam County	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15 × average seam thickness, less 20% mining loss
Clarion Co.				
Upper Freeport	43	26,700	21,400	9,200
Lower Freeport	46	28,400	22,700	10,400
Middle Kittanning	35	6,500	5,200	1,800
Lower Kittanning	35	57,000	45,600	16,000
Clarion ("Upper Clarion")	35	41,100	32,900	11,500
Brookville ("Lower Clarion")	34	53,800	43,000	14,600
Upper Mercer ("Brookville")	41	23,200	18,600	7,600
Total		236,700	189,400	71,100
Clearfield Co.				
Upper Freeport	33	40,800	32,600	10,800
Lower Freeport	38	83,700	67,000	25,500
Upper Kittanning	36	47,400	37,900	13,700
Middle Kittanning	34	39,100	31,300	10,600
Lower Kittanning	37	70,300	56,200	20,800
Brookville	44	17,500	14,000	6,200
Total		298,800	239,000	87,600
Fayette Co.				
Waynesburg	44	41,200	33,000	14,500
Sewickley	51	14,200	11,400	5,800
Pittsburgh	85	4,100	3,300	2,800
Upper Freeport	42	62,600	50,100	21,000
Total		122,100	97,800	44,100
Greene Co.				
Waynesburg	62	53,400	42,700	26,500
Sewickley	54	8,700	7,000	3,800
Pittsburgh	76	8,200	6,600	5,000
Total		70,300	56,300	35,300
Indiana Co.				
Pittsburgh	62	700	600	400
Upper Freeport	44	52,000	41,600	18,300
Lower Freeport	40	22,000	17,900	7,200
Lower Kittanning	38	20,200	16,200	6,200
Total		93,300	76,300	32,100

Table 6 (continued)

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15 × average seam thickness, less 20% mining loss
Jefferson Co.				
Upper Freeport . .	37	43,300	34,600	12,800
Lower Freeport . .	40	29,100	23,300	9,300
Lower Kittanning	30	28,200	22,600	6,800
Brookville	39	29,200	23,400	9,100
Total		129,800	103,900	38,000
Lawrence Co.				
Upper Freeport . .	42	2,400	1,900	800
Lower Freeport . .	42	8,700	7,000	2,900
Middle Kittanning	36	19,500	15,600	5,600
Lower Kittanning	36	2,100	1,700	600
Homewood	42	9,000	7,200	3,000
Upper Mercer . . .	42	2,000	1,600	700
Lower Mercer . . .	42	1,700	1,400	600
Quakertown	36	800	600	200
Total		46,200	37,000	14,400
Mercer Co.				
Brookville	48	42,200	33,800	16,200
Lower Mercer . . .	34	28,200	22,600	7,700
Sharon	38	22,900	18,300	7,000
Total		93,300	74,700	30,900
Somerset Co.				
Redstone	41	9,600	7,700	3,200
Pittsburgh	41	9,500	7,600	3,100
Upper Freeport . .	40	38,100	30,500	12,200
Lower Freeport . .	34	14,400	11,500	3,900
Upper Kittanning	41	65,000	52,000	21,300
Lower Kittanning	41	38,900	31,100	12,800
Total		175,500	140,400	56,500
Washington Co.				
Washington	57	76,100	60,900	34,700
Waynesburg	41	93,800	75,000	30,800
Redstone	35	7,200	5,800	2,000
Pittsburgh	65	27,300	21,800	14,200
Total		204,400	163,500	81,700

Table 6 (continued)

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15 × average seam thickness, less 20% mining loss
Westmoreland Co.				
Redstone	38	11,700	14,000	5,300
Pittsburgh	79	9,400	7,500	5,900
Upper Freeport ..	48	28,800	23,000	11,000
Total		55,700	44,500	22,200
Grand Total		2,272,500	1,818,200	752,300

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[1] Unpublished data from U. S. Bureau of Mines.

Table 7. Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by seam and sulfur content (thousands of short tons).[1,2]

Seam	Low Sulfur[2] (0-1%)	Medium Sulfur[2] (1-2%)	High Sulfur[2] (over 2%)
Washington	—	—	34,700
Waynesburg	—	—	71,800
Sewickley	—	—	9,600
Redstone	—	12,800[6]	7,300
Pittsburgh	—	32,500[7]	5,400
Brush Creek	—	—	300
Mahoning	—	—	2,000
Upper Freeport	—	52,800[8]	141,700
Lower Freeport	—	60,600[9]	38,400
Upper Kittanning	—	21,300[10]	25,400
Middle Kittanning	—	—	41,900
Lower Kittanning	—	23,400[11]	66,500
Clarion[3]	—	18,700[12]	11,200
Brookville[4]	—	—	46,100
Upper Mercer[5]	—	—	17,600
Lower Mercer	—	—	8,300
Quakertown	—	—	200
Sharon	—	7,000[13]	—
Total	—	229,100	523,200

[1] Adapted from Table A64 of *The reserves of bituminous coal and lignite for strip mining in the United States*, U. S. Bureau of Mines, Information Circular 8531.

[2] Based on the *average* "as received" sulfur content of each seam for each county. The *entire* tonnage of each seam for each county is assigned to the sulfur category corresponding to that seam's *average* sulfur content in that county.

[3] Referred to as "Upper Clarion" in Table 61 of U. S. Bureau of Mines report.

[4] Revised from Table 61 of U. S. Bureau of Mines report by adding "Lower Clarion" tonnage from Clarion County and subtracting "Brookville" tonnage from Clarion County.

[5] Revised from Table 61 of U. S. Bureau of Mines report by adding "Brookville" tonnage from Clarion County and "Homewood" tonnage from Lawrence County.

[6] Allegheny and Somerset Counties.

[7] Allegheny, Armstrong, Fayette, Somerset, Washington, and Westmoreland Counties.

[8] Allegheny, Cambria, Clearfield, Indiana, and Somerset Counties.

[9] Beaver, Butler, Clearfield, Indiana, Lawrence, and Somerset Counties.

[10] Somerset County.

[11] Beaver, Cambria, and Somerset Counties.

[12] Butler County.

[13] Mercer County.

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APPENDIX

IN-PLACE RESERVE CALCULATIONS

Appendix Table A shows the complete procedures involved in calculating the in-place reserves up to January 1, 1970. Numbers which were not originally rounded are not rounded in this table. Table A is included to permit checking of calculations and procedures, and also to allow future production to be subtracted with a minimum of duplicated effort.

Appendix Table B gives similar calculation procedures for reserves on the Pittsburgh seam.

RECOVERABLE COAL RESERVES

Appendix Tables C and D show the complete procedures involved in calculating the recoverable reserves up to January 1, 1970. Numbers not originally rounded are not rounded in these tables. Tables C and D are included to permit checking of calculations and procedures, and also to allow future production to be subtracted with a minimum of duplicated effort.

STRIPPABLE COAL RESERVE CALCULATIONS

The following is the sequence of operations performed in arriving at the tonnage figures given in the coal reserve tables (calculations were made separately for each seam in each of the 16 counties involved):

1. The linear length of the outcrop of each principal coal seam which averaged 28 inches thick or more in each county was plotted and measured.
2. Assuming that the maximum thickness of overburden which can be physically removed by modern stripping equipment is 120 feet, the average width of the strip of coal with less than 120 feet of cover was estimated for each seam.
3. The product of the linear length of outcrop multiplied by average width of coal with less than 120 feet of cover was computed giving the original total area of strippable coal.
4. The area of coal already stripped from each seam prior to January 1, 1968, was measured and subtracted from the original total strippable area, giving the remaining area of strippable coal as of that date.
5. An estimated average thickness for each seam was determined from available records. This thickness and a weight factor of 1800 tons per acre-foot were multiplied by the total remaining area of strippable coal as of January 1, 1968, yielding the remaining, strippable, in-the-ground tonnage for each seam. This figure is shown in the column entitled "Remaining coal resource, 0-120′ overburden" in Tables 1, 2, and 3.
6. The remaining, strippable, in-place tonnage was reduced by 20% to allow for an estimated 20% mining loss. The resulting figure represents the estimated total amount of coal which could be recovered if all lands bearing strippable coal were to be mined to 120 feet of cover. This figure is given in the column entitled "Remaining coal in place with 0 to 120 feet of overburden, less 20% mining loss" in Tables 4, 5, and 6.
7. On the basis that the ratio of overburden thickness to coal seam thickness cannot profitably exceed 15:1, the proportion of the 80% recoverable coal tonnage lying below cover exceeding 15 times the average thickness of the seam was subtracted from the total recoverable coal as derived in item 6. In practice, this economically recoverable coal is calculated by multiplying the total recoverable coal by the following fraction:

$$\frac{15\times \text{ (Average coal thickness in feet)}}{\text{120 feet}}$$

This figure appears in the column entitled "Remaining coal in place with overburden = to 15× average seam thickness, less 20% mining loss" in Tables 4, 5, and 6.

Starting with the "Remaining coal in place with overburden = 15× average seam thickness, less 20% mining loss" for each coal in each county, the following procedure was employed to produced a rough estimate of the amounts of that tonnage falling in low-sulfur (0 to 1%), medium-sulfur (1-2%), and high-sulfur (over 2%) categories:

1. From available "as received" raw coal analyses, an estimate was obtained of the average sulfur content of each seam in each county.
2. The *entire* tonnage for each seam in each county was assigned to the sulfur category corresponding to the *average* analysis. There was no attempt to prorate the tonnages among the three sulfur categories: The results of these calculations are given in Table 7.

Appendix Table A. *Unrounded calculation procedures for determination of in-place coal reserves by counties as of January 1, 1970 (short tons).*

FIELD COUNTY[1]	(1) Estimated original in-place reserves	(2) Minimum thickness included	(3) Source of original in-place reserves estimate	(4) Tonnage of last mined and lost estimate	(5) Effective date of last mined and lost estimate	(6) Source of last mined and lost estimate	(7) Strip mine production from date of previous estimate to 1/1/70[4]	(8) Factor to adjust strip production for mining loss (80% recovery)
MAIN BITUMINOUS AND GEORGES CREEK FIELDS								
Allegheny	3,194,820,000	18″	Reese & Sisler (1928)	1,370,000,000	1/1/43	Ashley (1944)	40,963,754	1.25
Armstrong	3,750,700,000	"	"	220,000,000	"	"	37,134,399	"
Beaver	2,516,530,000	14″	Patterson (1963)	28,000,000	1/1/56	Patterson (1963)	3,852,519	"
Blair	78,516,000	18″	Reese & Sisler (1928)	30,000,000	1/1/43	Ashley (1944)	2,301,649	"
Butler	3,677,800,000	14″	Patterson & VanLieu (1969)	222,000,000	1/1/66	Patterson & VanLieu (1969)	4,756,691	"
Cambria	5,383,000,000	18″	Reese & Sisler (1928)	865,000,000	1/1/43	Ashley (1944)	22,248,770	"
Cameron	61,560,000	"	"	200,000	1/1/1881	Estimate, this report	1,083,283	"
Centre	514,585,000	"	"	105,000,000	1/1/43	Ashley (1944)	19,221,574	"
Clarion	2,042,800,000	"	"	80,000,000	"	"	70,875,624	"
Clearfield	3,992,000,000	"	"	435,000,000	"	"	118,117,677	"
Clinton	114,380,000	"	"	20,000,000	"	"	13,335,753	"
Elk	559,781,000	"	"	80,000,000	"	"	7,201,259	"
Fayette	7,570,000,000	Not specified, but 24″ or less	Hickok & Moyer (1940)	2,000,000,000	"	"	17,496,989	"
Greene	9,464,215,000	18″	Reese & Sisler (1928)	173,000,000	"	"	2,624,466	"
Indiana	6,339,400,000	"	"	533,000,000	"	"	29,164,208	"
Jefferson	3,334,900,000	"	"	350,000,000	"	"	26,605,949	"
Lawrence	782,020,000	14″	VanLieu & Patterson (1964)	28,000,000	1/1/57	VanLieu & Patterson (1964)	12,214,787	"
McKean	422,865,000	18″	Reese & Sisler (1928)	2,000,000	1/1/43	Ashley (1944)	908,637	"
Mercer	499,680,000	"	"	90,000,000	"	"	12,399,813	"
Somerset	6,091,800,000	"	"	400,000,000	"	"	42,102,911	"

Venango	400,000,000[2]	"	Approximation, this report[2]	200,000	1/1/1881	Estimate, this report	12,817,972	"
Washington	10,526,023,000	"	Reese & Sisler (1928)	1,020,000,000	1/1/43	Ashley (1944)	48,146,175	"
Westmoreland	6,381,504,000	"	"	1,595,000,000	"	"	18,394,813	"
Field Total	77,704,779,000							
BROAD TOP FIELD								
Bedford	259,632,000	18"	Reese & Sisler (1928)	40,000,000	1/1/43	Ashley (1944)	2,631,192	1.25
Fulton	30,186,000	"	"	1,000,000	"	"	1,181,054	"
Huntingdon	125,136,000	"	"	30,000,000	"	"	3,028,585	"
Field Total	414,954,000							
NORTH-CENTRAL FIELDS								
Bradford	44,440,000	18"	Reese & Sisler (1928)	20,000,000	1/1/43	Ashley (1944)	191,605	1.25
Lycoming	72,000,000	"	"	7,000,000	"	"	1,095,712	"
Sullivan	35,000,000	24"	Ashley (1945)	25,000,000	1/1/45	Ashley (1945)	312,054	"
Tioga	155,432,000	18"	Reese & Sisler (1928)	26,000,000	1/1/43	Ashley (1944)	5,154,449	"
Field Total	306,872,000							
ANTHRACITE FIELDS								
Carbon	630,000,000	24"	Ashley (1945)	274,000,000	1/1/45	Ashley (1945)	11,109,528	1.25
Columbia	615,000,000	14"	"	105,000,000	"	"	7,749,405	"
Dauphin	870,000,000	24"	[8]	132,000,000	"	"	317,562	"
Lackawanna	2,030,000,000	"	Ashley (1945)	1,532,000,000	"	"	15,879,187	"
Lebanon	1,000,000,000	14"	[8]	4,000,000	"	Estimate, this report	239,216	"
Luzerne	4,525,000,000	24"	Ashley (1945)	2,419,000,000	"	Ashley (1945)	55,724,199	"
Northumberland	2,600,000,000	"	"	573,000,000	"	"	24,350,755	"
Schuylkill	12,130,000,000	"	"	1,950,000,000	"	"	96,658,045	"
Susquehanna	15,000,000	"	"	10,000,000	"	"	207,391	"
Wayne	10,000,000	"	"	4,000,000	"	"	28,624	"
Field Total	24,425,000,000							
PENNSYLVANIA TOTAL[1]	102,851,605,000							

Appendix Table A *(Continued)*

FIELD COUNTY[1]	(9) Strip mine production and losses from date of previous estimate to 1/1/70 (7 × 8)	(10) Deep mine production from date of previous estimate to 1/1/70[5, 6]	(11) Prorated "small" mine production 1945-1954[7] (if applicable)	(12) Total deep mine production from date of previous estimate to 1/1/70 (10 + 11)	(13) Estimated percent recovery in deep and auger mining	(14) Factor to adjust deep mine recovery for mining loss $\left(\frac{100}{\%\ \text{recovery}}\right)$	(15) Deep coal mined and lost from date of previous estimate to 1/1/70 (12 × 14)	(16) Total coal mined and lost to 1/1/70 (4 + 9 + 15)	(17) Total remaining reserves as of 1/1/70 (1-16)
MAIN BITUMINOUS AND GEORGES CREEK FIELDS									
Allegheny	51,204,693	200,290,149	218,400	200,508,549	53%[8]	1.89	378,961,158	1,800,165,851	1,394,654,149
Armstrong	46,418,174	78,394,018	1,075,200	79,469,218	48%[9]	2.08	165,295,973	431,714,147	3,318,985,853
Beaver	4,815,649	823,499	—	823,499	50%[10]	2.00	1,646,898	34,462,547	2,482,067,453
Blair	2,877,061	1,174,094	33,600	1,207,694	50%[10]	2.00	2,415,388	35,292,449	43,223,551
Butler	5,945,864	3,109,128	—	3,109,128	50%[10]	2.00	6,218,256	234,164,120	3,443,635,880
Cambria	27,610,963	271,163,669	2,150,400	273,314,069	47%[11]	2.13	582,158,967	1,474,769,930	3,908,230,070
Cameron	1,354,104	462,483	0	462,483	50%[10]	2.00	924,966	2,479,070	59,080,930
Centre	24,026,967	7,429,416	285,600	7,715,016	50%[10]	2.00	15,430,032	144,476,999	370,108,001
Clarion	88,594,530	10,109,397	571,200	10,680,597	53%[12]	1.89	20,186,328	188,780,858	1,854,019,142
Clearfield	147,647,096	52,786,897	1,360,800	54,147,697	53%[13]	1.89	102,339,147	684,986,243	3,307,013,757
Clinton	16,669,691	1,373,995	117,600	1,491,595	50%[10]	2.00	2,983,190	39,652,881	74,727,119
Elk	9,001,574	7,103,094	470,400	7,573,494	50%[10]	2.00	15,146,988	104,148,562	455,632,438
Fayette	21,871,236	190,585,122	1,108,800	191,693,922	65%[14]	1.54	285,208,620	2,307,079,856	5,262,920,144
Greene	3,280,582	279,030,348	151,200	279,181,548	64%[15]	1.56	435,523,215	611,803,797	8,852,411,203
Indiana	36,455,260	158,790,660	2,066,400	160,857,060	49%[16]	2.04	328,148,402	897,603,662	5,441,796,338
Jefferson	33,257,436	28,983,711	957,600	29,941,311	64%[17]	1.56	46,708,445	429,965,881	2,904,934,119
Lawrence	15,268,484	215,981	—	215,981	50%[10]	2.00	431,962	43,700,410	738,319,590
McKean	1,135,459	0	0	0	50%[10]	2.00	0	1,135,459	421,729,541
Mercer	15,499,766	1,662,610	0	1,662,610	50%[10]	2.00	3,325,220	108,824,986	390,855,014
Somerset	52,628,639	80,804,957	2,788,800	83,593,757	52%[18]	1.92	160,499,003	613,127,642	5,478,672,358

Venango	16,022,465	313,171	16,800	329,971	50%[10]	2.00	659,942	16,882,407	383,117,593
Washington	60,182,719	350,045,377	504,000	350,549,377	63%[19]	1.59	577,373,509	1,637,556,228	8,888,466,772
Westmoreland	22,993,516	132,955,847	1,125,600	134,081,447	65%[20]	1.54	206,385,428	1,824,378,944	4,557,125,056
Field Total								13,667,152,929	64,031,653,071
BROAD TOP FIELD									
Bedford	3,288,990	6,413,798	789,600	7,203,398	50%[10]	2.00	14,406,796	57,695,786	201,936,214
Fulton	1,476,317	179,523	0	179,523	50%[10]	2.00	359,046	2,835,363	27,350,637
Huntingdon	3,785,981	3,131,001	84,000	3,215,001	50%[10]	2.00	6,430,002	40,215,983	84,920,017
Field Total								100,747,132	314,206,868
NORTH-CENTRAL FIELDS									
Bradford	239,506	2,205	0	2,205	50%[10]	2.00	4,410	20,243,916	24,196,084
Lycoming	1,369,640	335,806	16,800	352,606	50%[10]	2.00	705,212	9,074,852	62,925,148
Sullivan	390,070	394,299	0	394,299	50%[10]	2.00	788,598	26,178,668	8,821,332
Tioga	6,443,061	1,634,345	117,600	1,751,945	50%[10]	2.00	3,503,890	35,946,951	119,485,049
Field Total								91,444,387	215,427,613
ANTHRACITE FIELDS									
Carbon	13,886,910	17,248,258	15,151	17,263,909	59%[21]	1.69	29,176,006	317,062,916	312,937,084
Columbia	9,686,756	10,416,576	719,784	11,136,360	64%[22]	1.56	17,372,772	132,059,368	482,940,632
Dauphin	396,953	1,004,370	664,612	1,668,982	54%[23]	1.85	3,087,617	135,484,570	734,515,430
Lackawanna	19,848,984	62,797,020	196,364	62,993,384	71%[24]	1.41	88,820,671	1,640,669,655	389,330,345
Lebanon	299,020	36,515	45,316	81,831	54%[23]	1.85	151,387	4,450,407	995,549,513
Luzerne	65,655,169	180,622,168	196,364	180,818,532	60%[25]	1.67	301,966,948	2,790,622,197	1,734,377,803
Northumberland	30,438,444	42,080,244	6,334,015	48,414,259	64%[22]	1.56	76,126,344	679,564,788	1,920,435,212
Schuylkill	120,822,556	96,119,067	6,921,966	103,041,033	60%[20]	1.67	172,078,525	2,242,901,081	9,887,098,919
Susquehanna	259,239	0	0	0	71%[24]	1.41	0	10,259,239	4,740,761
Wayne	35,798	394,299	0	12,027	71%[24]	1.41	16,948	4,052,728	5,947,272
Field Total								7,957,126,949	16,467,873,051
PENNSYLVANIA TOTAL[1]								21,816,471,397	81,029,133,603

Appendix Table A *(Continued)*

[1] Small original reserves in Crawford, Erie, Forest, Potter, Warren, and Wyoming Counties have not been calculated or estimated, and are excluded.

[2] In-place reserves have never been calculated for Venango County, the approximation used is derived by comparison to McKean and Mercer Counties which are underlain by the same coal seams and have similar coal-bearing areas.

[3] Based on extrapolation from partial tonnages given in U.S.G.S. Prof. Paper 602, as follows:

(A) With Wood and others (1969) reserves for 66% of the coal-bearing area of Lebanon County being given as 0.66 billion tons, the remaining 34% is prorated at 0.34 billion tons, yielding a total of 1.00 billion tons.

(B) The portion of Dauphin County covered by Wood and others (1969) is reported to contain 0.44 billion tons. The coal-bearing portion of Dauphin County not included in Wood and others (1969) is equal to 65% of the coal-bearing area of Lebanon County included in Wood and others (1969) and which is reported to contain 0.66 billion tons, and thus that portion of Dauphin County is prorated at 0.65 × 0.66 or 0.43 billion tons. The sum of the reserves for these two parts of the coal-bearing portion of Dauphin County is 0.44 billion tons plus 0.43 billion tons or 0.86 billion tons total.

[4] Bases for strip mine production figures:

(A) 1881-1942: (Venango and Cameron Counties) Pa. Dept. of Mines and Mineral Industries Annual Reports. Proportion of total production assignable to strip mining is estimated.

(B) 1943-1944: U. S. Bureau of Mines Mineral Yearbooks, except Elk, Fulton, McKean, and Greene in 1943 and Huntingdon and Lycoming in 1944 which are from Pa. Dept. of Mines and Mineral Industries Annual Reports.

(C) 1945: Strip mine production for Sullivan, Carbon, Columbia, Dauphin, Lackawanna, Lebanon, Luzerne, Northumberland, Schuylkill, Susquehanna and Waye is prorated from the total combined 1945 strip mine production for all these counties based on the ratio of 1946 strip mine production for each county to the total combined 1946 strip mine production for all of these counties, as given in the Pa. Dept. of Mines and Mineral Industries Annual Reports. All other counties are as reported in the 1945 Pa. Dept. of Mines and Mineral Industries Annual Report.

(D) 1946-1969: Pa. Dept. of Mineral Industries Annual Report.

[5] Bases for deep mine production figures:

(A) 1881-1942: (Venango and Cameron Counties) Pa. Dept. of Mines and Mineral Industries Annual Reports. Proportion of total production assignahle to deep mining is estimated.

(B) 1943-1944: Derived from U. S. Bureau of Mines Minerals Yearbooks by subtracting strip mine production from total production, except Elk, Fulton, McKean, and Greene in 1943 and Huntingdon and Lycoming in 1944 which are from Pa. Dept. of Mines and Mineral Industries Annual Reports.

(C) 1945: Deep mine production for Sullivan, Carbon, Columbia, Dauphin, Lackawanna, Lebanon, Luzerne, Northumberland, Schuylkill, Susquehanna and Wayne is pro-rated from the total combined 1945 deep mine production for all these counties based on the ratio of 1946 deep mine production for each county to the total combined 1946 deep mine production for all of these counties, as given in the Pa. Dept. of Mines and Mineral Industries Annual Reports. All other counties are as reported in the 1945 Pa. Dept. of Mines and Mineral Industries Annual Report.

(D) 1946-1969: Pa. Dept. of Mines and Mineral Industries Annual Reports.

[6] Does not include certain so-called "small" deep mine production from 1945 through 1954. Includes all auger mining.

[7] Source Pa. Dept. of Mines and Mineral Industries Annuals. Annual production for the years 1947 through 1954 for so-called "small" deep mines (five or fewer employees) was reported separately and not broken down for counties. Production for "small" mines was not reported prior to 1947. Annual production for "small" mines is prorated to each county for the years 1945 through 1954 in proportion to the percentage of the total 1955 "small" mine production reported for each county. Total "small" mine production for each 1945 and 1946 is approximated as follows: Total "small" mine production for Sullivan, Carbon, Columbia, Dauphin, Lackawanna, Lebanon, Luzerne, Northumherland, Schuylkill, Susquehanna, and Wayne—1,000,000 tons each year. Total "small" mine production for all other counties—1,906,222 tons each year.

[8] Based on Wallace and others (1953b), average of Pittsburgh coal at 49% and Upper Freeport at 57%.

[9] Weighted average of production for Armstrong Co. as given in Dowd and others (1951a).

[10] Estimated.

[11] Weighted average from Dowd and others (1950a).

[12] Estimated from selected figures on the Lower Kittanning seam in Blaylock and others (1956).

[13] Estimated from figures in Blaylock and others (1955).

[14] Based on weighted average recovery of Pittsburgh seam for Masontown and Uniontown Quadrangles as given in Dowd and others (1951b).

[15] Based on weighted average recovery of Pittsburgh seam for Masontown, and Waynesburg Quadrangles as given in Wallace and others (1955b).

Appendix Table A *(Continued)*

[16] Based on weighted average of recovery as reported in Dowd and others (1950b).

[17] Based on selected recovery figures for Lower Freeport and Lower Kittanning seams as given in Dowd and others (1952).

[18] Based on weighted average of selected recovery figures as given in Wallace and others (1953a).

[19] Based on weighted average recovery of the Pittsburgh seam in Brownsville, Amity, and Carnegie Quadrangles as given in Wallace and others (1955a).

[20] Based on weighted average of selected recovery figures for the Pittsburgh and Upper Freeport seams as given in Dowd and others (1951c).

[21] Based on recovery for Eastern Middle and Southern Anthracite Fields given in Ashmead (1926) and prorated on the proportion of Carbon Co. production from each field based on Table 7 of Ashley (1945).

[22] Based on recovery for Western Middle Anthracite Field given in Ashmead (1926). Columbia Co. production from Eastern Middle Field is negligible.

[23] Based on recovery for Southern Anthracite Field given in Ashmead (1926).

[24] Based on recovery for Northern Anthracite Field given in Ashmead (1926).

[25] Based on recovery for Northern and Western Middle Anthracite Fields given in Ashmead (1926) and prorated on the proportion of Luzerne Co. production from each field based on Table 7 of Ashley (1945).

[26] Based on recovery for Southern, Western Middle, and Eastern Middle Anthracite Fields given in Ashmead (1926) and prorated on the proportion of Schuylkill Co. production from each field based on Ashley (1945).

Appendix Table B. *Unrounded calculation procedures for determination of in-place reserves of the Pittsburgh coal as of January 1, 1970 (short tons).*

County[1, 2]	(1) Source of base estimate	(2) Effective date of base estimate	(3) Base estimate over 14 in.[2, 3]	(4) Base estimate over 28 in.[3, 13]	(5) Production from effective date to 1/1/70[4]	(6) Estimated percentage of recovery	(7) Estimated factor to adjust production for mining losses $\left(\frac{100}{\%\ \text{recovery}}\right)$	(8) Mined and lost from effective date to 1/1/70 (5 × 7)	(9) Remaining in-place reserves over 14 in. as of 1/1/70 (3-8)	(10) Remaining in-place reserves over 28 in. as of 1/1/70[13] (4-8)
Allegheny	Wallace and others (1953b)	1/1/53	[5]	69,989,000	16,850,730	48.4%[7]	2.07	34,881,081	[5]	35,907,919
Armstrong	Dowd and others (1951a)	1/1/49	[5]	10,500,000	408,955	80.0%[8]	1.25	511,194	[5]	9,988,806
Beaver	Patterson (1963)	1/1/56	Exhausted	Exhausted	[6]	—	—	—	Exhausted	Exhausted
Fayette	Dowd and others (1951b)	1/1/50	[5]	131,717,000	73,257,014	65.1%[9]	1.54	112,815,802	[5]	18,901,198
Greene	Wallace and others (1955b)	1/1/54	3,892,343,000	3,891,543,000	141,252,959	63.4%[10]	1.58	223,179,675	3,669,163,325	3,668,363,325
Indiana	Dowd and others (1950b)	1/1/48	[5]	7,085,000	1,423,364	80.0%[8]	1.25	1,779,305	[5]	5,305,695
Somerset	Flint (1965)	1/1/53	[5]	33,799,800	1,965,929	80.0%[8]	1.25	2,457,411	[5]	31,242,389
Washington	Wallace and others (1955a)	1/1/54	3,495,410,000	3,494,244,000	202,028,697	62.7%[11]	1.60	323,245,915	3,172,164,805	3,170,998,085
Westmoreland	Dowd and others (1951c)	1/1/50	[5]	192,203,000	37,186,392	72.4%[12]	1.38	51,317,211	[5]	140,885,789
Total									7,082,730,126	7,080,793,406[13]

[1] Does not include the small area of thin coal, questionably identified as "Pittsburgh," in Cambria County.

[2] Base sources report Pittsburgh coal exceeds 14 inches throughout entire area, except 323 acres in Greene Co. and 2031 acres in Washington Co.

[3] Original base estimate was given to nearest 1000 tons, except for Somerset Co., which was given to nearest 100 tons.

[4] Source: Pennsylvania Dept. of Mines and Mineral Industries Annual Report for years involved.

[5] Base sources report Pittsburgh coal always exceeds 28 inches thick.

[6] Small production reported is considered to be from outcrop coal and pillars already considered mined out and lost.

[7] Based on recovery for Carnegie Quadrangle as given in Wallace and others (1953b).

[8] Based on major part of the production being from strip mines and part of the tonnage being from outcrop and pillar coal already considered lost.

[9] Based on average recovery for Masontown and Uniontown Quadrangles as given in Dowd and others (1951b).

[10] Based on average recovery for Masontown and Waynesburg Quadrangles as given in Wallace and others (1955b).

[11] Based on weighted average recovery for Carnegie, Brownsville, and Amity Quadrangles as given in Wallace and others (1955a). Recovery percentage for Amity Quadrangle weighted at twice that of the other two quadrangles.

[12] Based on average recovery for Brownsville and Connellsville Quadrangles as given in Dowd and others (1951c).

[13] Base sources record that 99.9% of the over-28 inch base tonnage is also over 42 inches thick.

Appendix Table C. Unrounded calculation procedures for determination of recoverable coal reserves over 24 inches thick and over 28 inches thick by counties as of January 1, 1970.

FIELD COUNTY	(1) Source of last estimate	(2) Date of last estimate	(3) Recoverable reserves over 24″ as of date of last estimate	(4) Recoverable reserves between 24″ and 36″ as of date of last estimate	(5) Recoverable reserves between 24″ and 28″ as of date of last estimate (0.29 × col. 4)[2]	(6) Recoverable reserves over 28″ as of date of last estimate (3-5)	(7) Production from date of last estimates to 1/1/70	(8) Reserves over 24″ as of 1/1/70 (3-7)[3]	(9) Reserves over 28″ as of 1/1/70 (6-7)[4]
MAIN BITUMINOUS AND GEORGES CREEK FIELDS									
Allegheny	Ashley (1944)	1/1/43	1,095,000,000	595,000,000	173,000,000	922,000,000	241,472,303	853,527,697	680,527,697
Armstrong	,,	1/1/43	1,275,000,000	355,000,000	102,950,000	1,172,050,000	116,603,617	1,158,396,383	1,055,446,383
Beaver	Patterson (1963)	1/1/56	683,830,000[5]	—	—	354,260,000	4,676,018	679,153,982	349,583,982
Blair	Ashley (1944)	1/1/43	15,000,000	10,000,000	2,900,000	12,100,000	3,509,343	11,490,657	8,590,657
Butler	Patterson & Van Lieu (1969)	1/1/66	1,144,370,000[5]	—	—	865,294,000	7,865,819	1,136,504,181	857,428,181
Cambria	Ashley (1944)	1/1/43	1,700,000,000	1,400,000,000	406,000,000	1,294,000,000	295,562,839	1,404,437,161	998,437,161
Cameron	,,	original	20,000,000	20,000,000	5,800,000	14,200,000	1,645,766	18,354,234	12,554,234
Centre	,,	1/1/43	145,000,000	120,000,000	34,800,000	110,200,000	26,936,590	118,063,410	83,263,410
Clarion	,,	,,	710,000,000	600,000,000	174,000,000	536,000,000	81,556,221	628,443,779	454,443,779
Clearfield	,,	,,	1,175,000,000	1,000,000,000	290,000,000	885,000,000	172,265,374	1,002,734,626	712,734,626
Clinton	,,	,,	30,000,000	20,000,000	5,800,000	24,200,000	14,827,348	15,172,652	9,372,652
Elk	,,	,,	155,000,000	100,000,000	29,000,000	126,000,000	14,774,753	140,225,247	111,225,247
Fayette	,,	,,	2,730,000,000	1,330,000,000	385,700,000	2,344,300,000	209,190,911	2,520,809,089	2,135,109,089
Greene	,,	,,	4,775,000,000	1,775,000,000	514,750,000	4,260,250.000	281,806,014	4,493,193,986	3,978,443,986
Indiana	,,	,,	2,340,000,000	1,540,000,000	456,600,000	1,883,400,000	190,021,268	2,149,978,732	1,693,378,732
Jefferson	,,	,,	1,200,000,000	900,000,000	261,000,000	939,000,000	56,547,260	1,143,452,740	882,452,740
Lawrence	Van Lieu & Patterson (1964)	1/1/57	173,650,000[5]	—	—	164,110,000	12,430,768	161,219,232	151,679,232
McKean	Ashley (1944)	,,	135,000,000	130,000,000	37,700,000	97,300,000	908,367	134,091,633	96,391,633
Mercer	,,	,,	125,000,000	100,000,000	29,000,000	96,000,000	14,062,423	110,937,577	81,937,577
Somerset	,,	,,	2,170,000,000	1,400,000,000	406,000,000	1,764,000,000	125,696,668	2,044,303,332	1,638,303,332
Venango	This report	original	130,000,000[6]	125,000,000[6]	36,250,000	94,000,000	13,247,943	116,752,077	80,752,077
Washington	Ashley (1944)	1/1/43	4,695,000,000	1,695,000,000	491,550,000	4,203,450,000	398,695,552	4,296,304,448	3,804,754,448
Westmoreland	,,	,,	2,340,000,000	840,000,000	243,600,000	2,096,400,000	152,476,260	2,187,523,740	1,943,923,740
Field Total								26,525,070,595	21,820,986,595
BROAD TOP FIELD									
Bedford	Ashley (1944)	1/1/43	80,000,000	15,000,000	4,350,000	75,650,000	9,834,590	70,165,410	65,815,410
Fulton	,,	,,	11,000,000	7,000,000	2,030,000	8,970,000	1,360,577	9,639,423	7,609,423
Huntingdon	,,	,,	30,000,000	20,000,000	5,800,000	24,200,000	6,243,586	23,756,414	17,956,414
Field Total								103,561,247	91,381,247

NORTH-CENTRAL FIELDS										
Bradford	Ashley	(1944)	1/1/43	6,000,000	5,000,000	1,450,000	4,550,000	193,810	5,806,190	4,356,190
Lycoming	,,		,,	24,000,000	20,000,000	5,800,000	18,200,000	1,448,318	22,551,682	16,751,682
Sullivan	Ashley	(1945)	1/1/45	5,000,000	—	—	est. 4,000,000	706,353	4,293,647	3,293,647
Tioga	Ashley	(1944)	1/1/43	26,000,000	20,000,000	5,800,000	20,200,000	6,906,394	19,093,606	13,293,606
Field Total									51,745,125	37,695,125
ANTHRACITE FIELDS										
Carbon	Ashley	(1945)	1/1/45	178,000,000	—	—	—	28,373,437	149,626,563	[8]
Columbia	,,		,,	255,000,000	—	—	—	18,885,765	236,114,235	[8]
Dauphin	[7]		,,	349,000,000[5]	—	—	335,000,000	1,986,544	347,013,456	333,013,456
Lackawanna	Ashley	(1945)	,,	249,000,000	—	—	—	78,872,571	170,127,429	[8]
Lebanon	[7]		,,	469,000,000[5]	—	—	453,000,000	321,029	468,678,971	452,678,971
Luzerne	Ashley	(1945)	,,	1,053,000,000	—	—	—	236,542,731	816,457,269	[8]
Northumberland	,,		,,	1,013,000,000	—	—	—	72,765,014	940,234,986	[8]
Schuylkill	,,		,,	5,090,000,000	—	—	—	199,699,078	4,890,300,922	[8]
Susquehanna	,,		,,	2,500,000	—	—	—	207,391	2,292,609	[8]
Wayne	,,		,,	3,000,000	—	—	—	40,651	2,959,349	[8]
Field Total									8,023,805,789	[8]
PENNSYLVANIA TOTAL EXCEPT ANTHRACITE FIELDS									26,680,376,967	21,950,062,967
PENNSYLVANIA TOTAL									34,407.182,756	—

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[1] Small recoverable reserves in Crawford, Erie, Forest, Potter, Warren, and Wyoming Counties have not been estimated and are excluded.

[2] 0.29 is the factor used in deriving the proportion of the entire tonnage occurring in beds between 24 and 36 inches thick which is in beds between 24 and 28 inches thick. It assumes an even distribution of bed thicknesses between 24 and 36 inches thick.

[3] Assumes all production has been from beds over 24 inches thick.

[4] Assumes all production has been from beds over 28 inches thick.

[5] Based on the sum of the remaining recoverable reserves over 28 inches thick and 0.354 × the reserves between 14 and 28 inches thick. 0.354 is the factor used in deriving the proportion of the entire tonnage occurring in beds between 14 and 28 inches thick which is in beds between 24 and 28 inches thick, assuming an even distribution of bed thicknesses between 14 and 28 inches thick.

[6] Estimated by comparison to McKean County figures in Pennsylvania's Mineral Heritage.

[7] Based on extrapolation of partial figures for Dauphin and Lebanon Counties in Wood and others (1969). See also footnote 3 of Appendix Table A.

[8] Reserves over 28 inches cannot be calculated directly for these counties. It is probably 90% or more of the tonnage over 24 inches thick.

Appendix Table D. Calculation procedures for estimation of recoverable coal over 36 inches thick to Pennsylvania exclusive of the Anthracite Fields as of January 1, 1970 (millions of tons).

FIELD COUNTY	Previous Estimate[1]	Approximate production since previous estimate[2]	Approximate remaining reserves over 36" as of 1/1/70
MAIN BITUMINOUS AND GEORGES CREEK FIELDS			
Allegheny	500	240	260
Armstrong	920	90	830
Beaver	200	2	198
Blair	5	2	3
Butler	370	4	366
Cambria	670	280	390
Cameron	0	0	0
Centre	25	22	3
Clarion	110	30	80
Clearfield	175	85	90
Clinton	10	4	6
Elk	55	9	46
Fayette	1,300	200	1,100
Greene	3,000	280	2,720
Indiana	800	168	632
Jefferson	300	37	263
Lawrence	80	3	77
McKean	5	0	5
Mercer	25	4	21
Somerset	770	100	670
Venango	10	3	7
Washington	3,000	390	2,610
Westmoreland	1,300	145	1,255
Field Total	13,630	—	11,532
BROAD TOP FIELD			
Bedford	65	8	57
Fulton	4	0	4
Huntingdon	10	4	6
Field Total	79	–	67
NORTH-CENTRAL FIELDS			
Bradford	1	0	1
Lycoming	4	0	4
Sullivan	0	0	0
Tioga	6	2	4
Field Total	11	–	9
PA. TOTAL (EXCEPT ANTH. FIELDS)	13,820	—	11,707

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[1] Based on figures in Ashley (1944), as of January 1, 1943, except Beaver County which is derived from figures in Patterson (1963), Cambria County which is derived from figures in Dowd and others (1950a), Lawrence County which is derived from figures in Van Lieu and Patterson (1964), Butler County which is derived from figures in Patterson and Van Lieu (1969), and Venango and Sullivan Counties which are estimated.

[2] Estimated proportion of total production.